Studies in Cyperaceae in southern Africa. 25: *Schoenoplectus tabernaemontani*

J. Browning,[1]* K.D. Gordon-Gray[1] and S. Galen Smith[2]

[1]Department of Botany, University of Natal, P.O. X01, Scottsville 3209, Republic of South Africa

[2]Department of Biology, University of Wisconsin-Whitewater, Whitewater, Wisconsin 53190, USA

Received 27 July 1994; revised 2 November 1994

Southern African plants previously known as *Schoenoplectus lacustris* (L.) Palla or *Scirpus lacustris* L. are recircumscribed morphologically, and distributional and habitat details are given. They are transferred to *Sch. tabernaemontani* (C.C. Gmel.) Palla, which includes *Sch. validus* (Vahl) A. Löve & D. Löve, and with which they fit more precisely. The broad conception of *Scirpus lacustris* L. as a complex species incorporating *S. tabernaemontani* C.C. Gmel. is more effectively treated as several individual species, in many cases linked in certain parts of their ranges by natural hybrids.

Die plante van suidelike Afrika wat voorheen as *Schoenoplectus lacustris* (L.) Palla of *Scirpus lacustris* L. bekend was, word morfologies heromskryf en verspreidings- en habitatbesonderhede word gegee. Hulle word oorgeplaas na *Sch. tabernaemontani* (C.C. Gmel.) Palla, wat *Sch. validus* (Vahl) A. Löve & D. Löve insluit, waarby hulle beter inpas. Die wye begrip van *Scirpus lacustris* L. as 'n kompleks wat *S. tabernaemontani* C.C. Gmel. insluit, word meer effektief behandel as verskeie individuele spesies wat dikwels in sekere dele van hul verspreidingsgebiede deur natuurlike hibriede verbind word.

Keywords: *Schoenoplectus tabernaemontani*, *Sch. lacustris*, southern Africa, taxonomy.

* To whom correspondence should be addressed.

Introduction

Species delimitation among *Scirpus lacustris* and its allies has long presented problems because of close morphological relationships and the occurrence of natural hybrids. In the most recent world-wide study, Koyama (1962: 922) summarized the morphological differences, as agreed upon by most specialists, of the two European constituents *S. lacustris* L. and *S. tabernaemontani* C.C. Gmel. and commented that there was lack of consensus as to whether these distinctions provided adequate reason to warrant the specific status of *S. tabernaemontani*. Study of Eurasian and North American representatives, including *S. validus* Vahl, *S. acutus* Muhl. ex Bigelow and *S. heterochaetus* Chase, led him to the conviction that this alliance of closely related species was very often linked by intermediates and was most satisfactorily treated as a complex under *Scirpus lacustris*.

Increasing knowledge of the *S. lacustris* complex worldwide, together with accumulating evidence of the heterogeneity of *Scirpus s.l.*, has stimulated detailed reassessment of its components. Following soon after Koyama's publications (1958, 1962, 1963), Smith (1969) in north central United States showed the advantage of the recognition of three separate species because of '... the distinctness of the taxa in large regions of sympatry ...' and other reasons, and despite the abundance of hybrids in intensively disturbed habitats. Similar conclusions were reached by Dabbs (1971) and Shay *et al.* (1989) in central Canada. Bakker (1954) in the Netherlands initially concluded that *Scirpus tabernaemontani* should be treated as a subspecies of *S. lacustris* because of the presence of putative hybrids of undiminished fertility, but shortly before his death he changed his opinion and considered *S. tabernaemontani* to be a separate species (Bakker 1969, pers. commun. to S.G. Smith). Klimko (1992) studied both fossil and present materials in Europe and compared them with North American plants and concluded that *Sch. lacustris, tabernaemontani, validus* and *acutus* are distinct species. Smith (1994, 1995) reassessed the complex for the Flora of North America and on a wider geographical basis and has concluded that *Sch. lacustris, acutus, heterochaetus* and *tabernaemontani* (including *validus*) should be accepted as species.

Under *Scirpus lacustris*, plants were reported for southern Africa by Clarke (1894: 624; 1897/98: 231), Schonland (1922: 37), Podlech (1967: 49) and Forbes (1987: 62). With acceptance of the dismemberment of *Scirpus* L. *sensu lato*, later citations were as *Schoenoplectus lacustris* (L.) Palla by Reid (1985: 76; 1993: 109). It is thus evident that the southern African plants need re-study and taxonomic re-evaluation. This paper provides such information.

Results and Discussion

Our study of southern African specimens of this complex indicate that they belong to *Sch. tabernaemontani s.lat.* rather than to *Sch. lacustris* or any other species. They are distinguishable from *Sch. lacustris s.s.*, as defined by, for example, Koyama (1962), DeFillips (1980) and Casper and Krausch (1980), by the following characteristics, summarized in order of importance:

(i) Lenticular, mucronate, smaller achenes.
(ii) Predominantly bifid styles.
(iii) Floral scales, especially those low in the spikelet, scabrous abaxially in the vicinity of the midrib.
(iv) Floral scale midribs very shortly excurrent and nearly straight, 0.25–0.5 mm long.

Sch. tabernaemontani is not uniform, and opinions have differed concerning its relationship with *Sch. validus*. Raymond (1957: 140) tentatively united *Scirpus tabernaemontani* and *validus* and commented '... [they] are very closely related if not conspecific.' Koyama (1962, 1963) at first placed these two taxa in separate subspecies of *Scirpus lacustris*, but later (Koyama 1978: 209–210) he considered them to be separate species but questioned their distinctness because of the presence of intermediate plants, perhaps due to hybridization. He placed the Taiwanese plants in *Schoenoplectus validus* and gave the range of this species as 'widely spread in temperate regions [of Asia and North America] and on tropical high mountains of North and South America,

Pacific Islands, Australia, Malesia and southern Asia', while stating that '... *S. tabernaemontani* ... extends chiefly into the northern temperate regions of northern Eurasia and North America'. Wilson (1981: 161) placed Australian plants in *Sch. validus* and gave its range as 'Australian states except the Northern Territory; countries bordering the Pacific ocean; New Caledonia, New Hebrides'. Smith (1994), supported by A.E. Schuyler at The Academy of Natural Sciences of Philadelphia, PA, USA, concluded that *Sch. tabernaemontani* and *validus* differ very little, intergrade completely in North America and Eurasia, and definitely should be united. *Schoenoplectus tabernaemontani,* as thus broadly defined, is nearly worldwide in distribution.

The southern African plants do not conform precisely with plants of *Sch. tabernaemontani s. lat.* we have seen from other parts of the world. One of us (S.G.S.) examined *Ward 12485* as a representative example and assessed its characteristics as follows: It is like most northern European *Sch. tabernaemontani* in that the spikelets are all clustered, 2 to ±11 per cluster, and the floral scales are rather dark orange-brown with reddish spinules on and near the midribs, especially low in the spikelet. However, it is like most North American and Asian plants in its very easily compressed culms. The floral scales hide the achenes instead of being short so that the achenes are partly exposed, as in many North American plants (= *Scirpus validus* var. *creber* Fernald) and many European plants of *Sch. tabernaemontani s.s.* The culm air spaces are large and the rhizome cortex is very thin, as appears to be true of *Sch. tabernaemontani* worldwide.

Formal taxonomy

Schoenoplectus tabernaemontani (C.C. Gmel.) Palla, Verhandlungen der kaiserlich-königlichen zoologisch-botanischen Gesellschaft Wien 38: 49 (1888).

Scirpus tabernaemontani C.C. Gmel.: 101 (1805). *Scirpus lacustris* L. ssp. *tabernaemontani* (C.C. Gmel.) Syme: 63 (1870). *S. lacustris* L. var. *tabernaemontani* (C.C. Gmel.) Doell: 165 (1943). TYPE: Europe, 'in Rheni vivinia' (KR).

Scirpus lacustris L. subsp. *glaucus* (J.E. Smith) C.J. Hartman: 10 (1846). *Scirpus glaucus* J.E. Smith pl. 2321 (1811), *non* Lamarck: 142 (1791). TYPE: Scotland, Galloway, on the sides of a saltmarsh on the west of Ardbigland, 1800, *J. Mackay 6* [lectotype, selected by S.G. Smith (1994), LINN-Smith 105.25, det. by Nicholas Turland and Clive Jermy at BM in 1994].

Scirpus validus M. Vahl: 268 (Oct. 1805 or later). *Scirpus lacustris* L. var. *validus* Kük.: 200 (1926 or 1927). *Schoenoplectus validus* (M. Vahl) A. Löve & D. Löve: 33 (1954). *Scirpus lacustris* L. subsp. *validus* (M. Vahl) T. Koyama: 927 (1962). TYPE: 'Habitat in Caribaeis', Dr. Banks?, Herb. *Vahl s.n.* (holotype?, C, det. S.F. Blake 1961 & A.E. Schuyler 1976).

Scirpus validus M. Vahl var. *creber* Fernald: 283 (1943). *Schoenoplectus validus* (M. Vahl) A. Löve & D. Löve var. *creber* (Fernald) A. Löve & D. Löve : 33 (1954). *Scirpus validus* M. Vahl subsp. *creber* (Fernald) T. Koyama: 458 (1963). TYPE: U.S.A., New York, Fisher's Island, August 10–15, *H. St. John 2581* (holotype, GH).

Scirpus tabernaemontani Vahl forma *luxurians* Miquel: 143 (1865). *Scirpus lacustris* subsp. *creber* var. *luxurians* (Miq.) T. Koyama: 458 (1963). *Schoenoplectus validus* (Vahl) A. Löve & D. Löve subsp. *luxurians* (Miquel) Soják: 62 (1972). TYPE: Japan: 'In ripa fluminis Jahaki Gawa ins Nippon', *No. 633* [lectotype, L., selected by S.G. Smith (1994)].

Scirpus lacustris sensu C.B. Clarke: 624 (1894), C.B. Clarke: 231 (1897/98); Schonland: 37 (1922); Podlech: 49 (1967); Forbes: 62 (1987) *non* L., *non* C.B. Clarke: 454 (1901/02), *non* Hutchinson: 467 (1936). *Schoenoplectus lacustris sensu* Reid: 76 (1985), Reid: 109 (1993) *non* (L.) Palla.

Perennial. *Rhizome* horizontal; 8–20 mm in diameter when dry, then cortex thin, about 0.5–1.4 mm thick, central cylinder fibrous; clothed with equilaterally triangular, acute, membranous scales about 15 mm long. *Roots* fine, very numerous. *Culms* solitary, at intervals of (20–) 30–40 mm along rhizome, occasionally clustered, erect or bending over distally, (0.8–) 1.0–1.5 (–2.0) m × (1.0–) 2.2–3.5 mm below inflorescence and more or less 10 mm about midpoint, spongy, readily compressible, glabrous, glaucous. *Leaves* reduced to sheaths about 4 per culm, papery/membranous (thin-textured), closely and finely veined with cross-connections numerous, mouth long oblique, usually only uppermost 1–2 bearing a dorsiventrally flattened blade 10–15 mm long. *Ligule* a membranous flap, about 2 mm long. *Inflorescence* a pseudolateral (but often appearing pseudoterminal), supra decompound or compound anthela; rays numerous, mostly arising in bracteated groups from few points of branching, unequal, flattened, scabridulous, occasionally reduced to 1–2 so that inflorescence is contracted resembling a head. Involucral bracts several, lowest continuing line of culm, never surpassing inflorescence branches, 10–40 mm long, gradually narrowing to terminate in a stiff point. *Spikelets* sessile, clustered in groups of 2–15 terminating rays, rarely 1–few solitary within an inflorescence, ovoid to oblong-ovoid or elliptic-ovoid, 5.0–20.0 × 2.0–5.0 mm, many-flowered. *Glumes* spiral, all bearing flowers, ovate to oblong-ovate, 3.0–4.0 × 1.7–2.5 mm, keeled, flanks bright orange-brown to dark brown, reddish spotted, margins fimbriate especially apically, apices emarginate, midribs excurrent into a short mucro 0.25–0.5 mm long, keels, mucros and adjacent parts of flanks scabridulous distally on abaxial surface, especially of basal glumes. *Hypogynous bristles* 5–6, retrorsely barbed, 2.3–2.9 mm long. *Stamens* 3, filaments about 0.25 mm wide, persistent; anthers 1.4–1.8 mm long, including short, triangular-ovate, smooth, orange crest. Style 1.0–1.5 mm long, branches usually 2, but 3 in 2–3 lowest florets of most spikelets, papillae short, hardly projecting. *Achene* including mucro (beak) 2.4–3.0 × 1.3–1.8 mm, planoconvex with low, broadly rounded abaxial ridge, obovate in outline, apiculate, green becoming greyish-brown to black; surface appearing smooth ×20, slightly rough, lacking lustre ×40, exocarp cells more or less isodiametric to oblong, often with central, small boss. (Figure 1.)

Selected citations of specimens

—2017 (Waterberg): Wasserstelle, Otjenga (–AC), *Volk 1453* (M).

—2627 (Potchefstroom): Mooirivierloop, Plaas Kiel, suid van Muiskraalpad (–AC), *Ubbink 1250, 1306* (PRE, PRU, PUC); A. Bailey Nat. Reservaat, Lang kanaal (–AD), *Van Wyk, S. 451* (PRE, PUC); Vlei tussen Grimbeekpark en Miederpark (–CA), *Bredenkamp 17* (PRE, PUC).

—2628 (Johannesburg): W.W. Rand, Crown Mines Vlei (–AA), *Lister J 25521* (J, PRE); South of Alberton on road to Heidelburg near Natalspruit (–AA), *Forbes 416* (J, NU); 15 km S. of Benoni on direct road to Heidelburg (–AD), *Ward 9148* (NU, PRE).

—2630 (Carolina): Chrissiemeer (–AC), *Edwards T. 1041* (NU).

—2725 (Bloemhof): Lovemore Farm nr. Christiana (–CC), *Burtt-Dayy 11218* (PRE).

—2728 (Frankfort): 9 km S of Warden on main road (N3) to Harrismith (–DD), *Ward 12485* (NU).

—2821 (Upington): Stream below Strawan (–BC), *Britten 6581* (GRA, PRE).

—2823 (Griekwastad): Hay Region; Papkuil (–BC), *Wilman 610* (KMG).

—2824 (Kimberley): Left bank of Modder River at Makow's Drift (–DB), *Acocks H1283* (PRE).

—2829 (Harrismith): Harrismith; Plantai Oraniensis (–AC), *Thode A543* (PRE).

—2927 (Maseru): Near Tweespruit (–AA), *Armour RAK1* (NU);

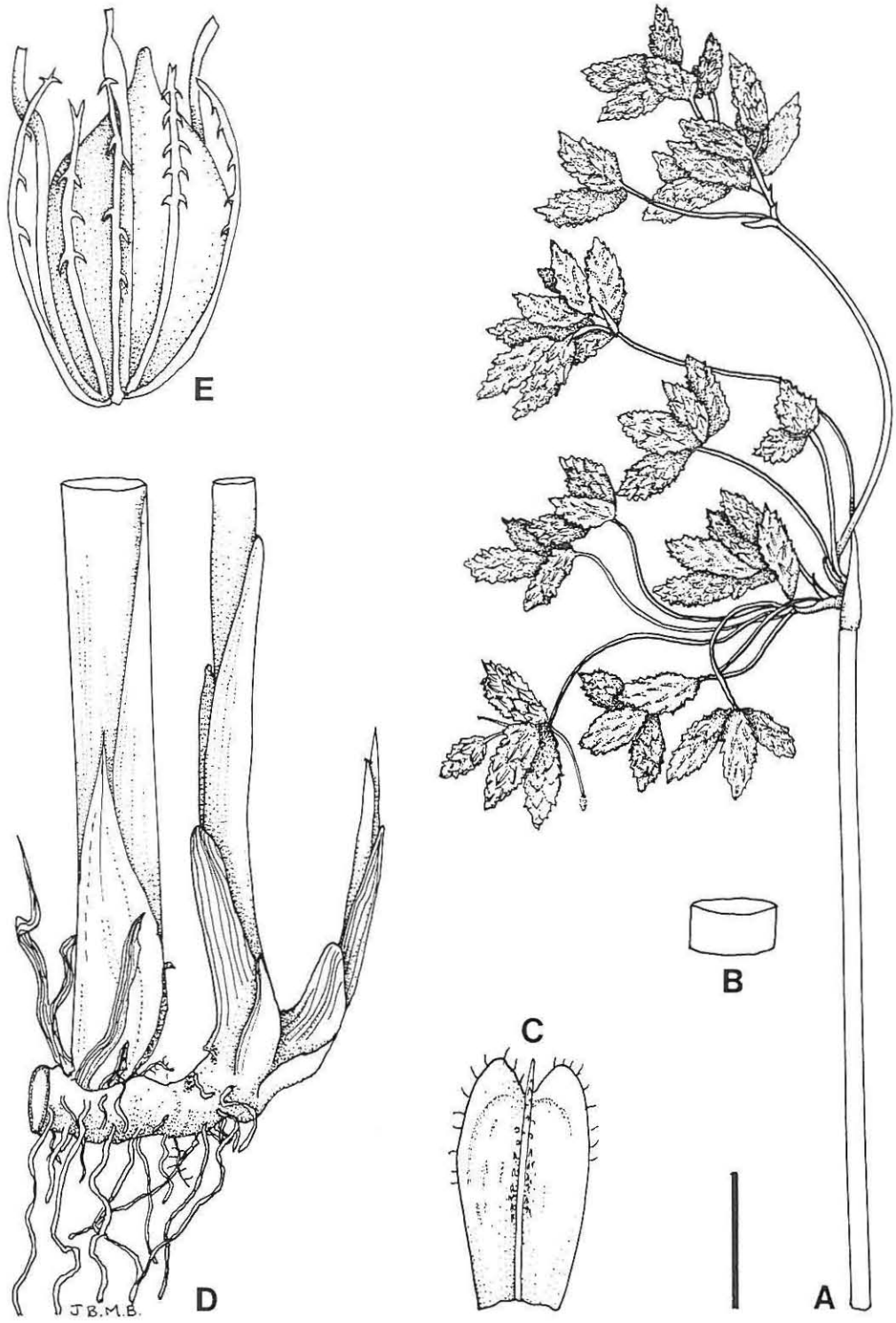

Figure 1 *Schoenoplectus tabernaemontani*. A. Inflorescence, scale bar 20 mm. B. Section of culm 10 mm below inflorescence, scale bar 4 mm. C. Glume, scale bar 2 mm. D. Part of plant base, scale bar 20 mm. E. Achene, scale bar 1 mm. *Forbes 416* (NU).

Maroh ? below the village of Iotata ?. Mafeteng Distr. (–CD), *Dieterlen 1329* (PRE, SAM).

—3125 (Steynsburg): Distr. Middelburg, CP. Grootfontein (College?) (–AC), *Gill 1* (PRE).

Distribution and habitat

Sch. tabernaemontani has a limited distribution in southern Africa (Figure 2) and is not known from the remainder of the sub-Saharan region. Clarke (1901/02) gave a record from Sierra Leone (as *Scirpus lacustris*), but Hooper (1972) referred the only gathering cited (*Afzelius 498*) to *Scirpus pterolepis* (Nees) Kunth.

Known localities are limited to the drainage area of the Vaal/Orange River system (Chrissiemeer, pans near the source of Vaal), except for one record from Namibia not cited by Podlech (1967: 49) (*Volk 1453*, M). The specimen cited for the same country (*Dinter 2329*, as *Scirpus lacustris*) we have not been able to trace. Both numbers were recorded for the Grootfontein district.

Plants occupy isolated pools and small dams with fairly deep,

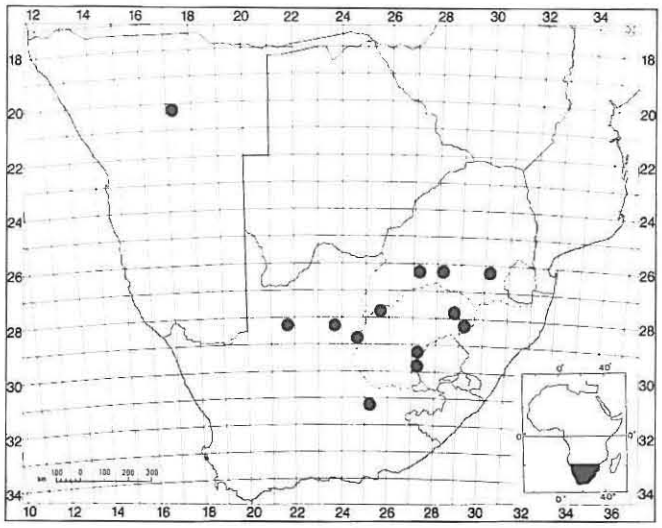

Figure 2 Recorded known distribution of *Schoenoplectus tabernaemontani* in southern Africa.

permanent water where there is some fresh-water input from time to time or continuously. Salinity records that are available suggest growth is most favourable in fresh water.

Acknowledgements

We are indebted to herbarium curators who very kindly loaned specimens for study. Mr. C.J. Ward is thanked for his meticulous field observations and for excellent representative voucher specimens.

References

BAKKER, D. 1954. Miscellaneous notes on *Scirpus lacustris* L. *sensu lat.* in the Netherlands. *Acta bot. neerl.* 3(4): 425–445.

CASPAR, S.J. & KRAUSCH, H.D. 1980. Süsswasserflora von Mitteleuropa, Band 23, Teil 1. Gustav Fischer Verlag, Stuttgart.

CLARKE, C.B. 1894. Cyperaceae. In: Conspectus Florae Africae 5, eds T. Durand & H. Schinz, pp. 526–692. Bruxelles.

CLARKE, C.B. 1897/98. Cyperaceae. In: Flora Capensis, 2nd edn., 7: 149–310. Reeve, London.

CLARKE, C.B. 1901/02. Cyperaceae. In: Flora of tropical Africa, 2nd edn., 8: 266–524. Reeve, London.

DABBS, D.L. 1971. A study of *Scirpus acutus* and *Scirpus validus* in the Saskatchewan River delta. *Can. J. Bot.* 49: 143–153.

DeFILLIPS, R.A. 1980. Scirpus L. In: Flora Europea 5, eds T.G. Tutin *et al.*, pp. 277–280. Cambridge Univ. Press, Cambridge.

DOELL, J.C. 1943. Rhein Flora: 165.

FERNALD, M.L. 1943. Studies in North American species of *Scirpus*. *Rhodora* 45: 279–297.

FORBES, P.L. 1987. Cyperaceae. In: Flora of the Witwatersrand: Monocotyledonae 1. eds T.K. Lowrey & S. Wright, pp. 29–64. Witwatersrand University Press, Johannesburg.

GLEASON, H.A. & CRONQUIST, A. 1991. Manual of Vascular Plants of Northeastern United States and Adjacent Canada, 2nd edn. The New York Botanical Garden, Bronx, New York.

GMELIN, C.C. 1805. Flora Badensis Alsatica 1: 101. Karlsruhe.

HARTMAN, C.J. 1846. Svensk och norsk excursions – flora: 10. Stockholm.

HOOPER, S.S. 1972. *Scirpus* L. In: Flora of West tropical Africa, 2nd edn., ed. F.N. Hepper, 3: 307–311.

HUTCHINSON, J. 1936. Cyperaceae. In: Flora of West tropical Africa 2: 464–495, eds. J. Hutchinson & J.M.Dalziel, Crown Agents, London.

KLIMKO, M. 1992. Studies of the variability of the recent and fossil species of the genus *Schoenoplectus* (Rchb.) Palla. [Polish text, English summary]. Seria Biologia No. 51, pp. 146. Adam Mickiewicz University Press, Poznan.

KOYAMA, T. 1958. Taxonomic study of the genus *Scirpus* Linn. *J. Fac. Sci. Univ. Tokyo* Vol. 7, pts. 4–6, pp. 270–366.

KOYAMA, T. 1962. The genus *Scirpus* Linn. Some North American aphylloid species. *Can. J. Bot.* 40: 913–937.

KOYAMA, T. 1963. The genus *Scirpus* Linn. Critical species of the section *Pterolepis*. *Can. J. Bot.* 41: 1107–1131.

KOYAMA, T. 1978. *Schoenoplectus*. In: Flora of Taiwan 5: 207–217, eds L. Hui-Lin, L. Tang-shui, H.Tseng-chieng, T. Koyama & C.E. DeVol. Epoch Publishing Co., Ltd., Taipei, Taiwan.

KUEKENTHAL, G. 1926. XV. Cyperaceae novae vel criticae imprimis antillanae. *Fedde's Reprium Spec. nov.* 23: 183–222.

LAMARK, J.B. 1791. Cyperaceae. In: Tableau encyclopedique et methodique des trois règnes de la nature 1: 133–151.

LÖVE, A & LÖVE, D. 1954. Vegetation of a prairie marsh. *Bull. Torrey Bot. Club* 81: 16–34.

MIQUEL, F.A. Guil. 1865–1866. Prolusio florae Japonicae. *Annls Musei Bot. Rijksmus. Netherlands* 2: 69–212.

PODLECH, D. 1967. Cyperaceae 165. In: Prodromus einer Flora von Südwestafrika, ed. H. Merxmüller, 175 pp. J. Cramer, Lehre.

RAYMOND, L.F.M. 1957. Some new or critical *Scirpus* from Indo-China. *Naturaliste Can.* 84: 111–149.

REID, C. 1985. Cyperaceae. In: List of species of southern African plants, eds. G.E. Gibbs Russell, C. Reid, J. van Rooy & L. Smook. *Mem. bot. Surv. S. Afr.* 51: 70–81.

REID, C. 1993. Cyperaceae. In: Plants of southern Africa: names and distribution, eds T.H. Arnold & B.C. de Wet. *Mem. bot. Surv. S. Afr.* 62: 102–116.

SCHONLAND, S. 1922. Introduction to South African Cyperaceae. *Mem. bot. Surv. S. Afr.* 3: 1–72. Govt. Printer, Pretoria.

SHAY, J.M., MACAULAY, A.J. & FREGO, KA. 1989. A morphological comparison of *Scirpus acutus* and *S. validus* in southern Manitoba. *Can. J. Bot.* 66: 2331–2337.

SMITH, J.E. 1811. English botany 33, plate 2321.

SMITH, S.G. 1969. Natural hybridisation in the *Scirpus lacustris* complex in north central United States. In: Current Topics in Plant Science, pp. 175–200, ed. J.E. Gunckel, 461 pp. Academic Press, New York, London.

SMITH, S.G. 1994. *Scirpus s.lat.* (Cyperaceae): Innovations in North American *Schoenoplectus, Isolepis* and *Trichophorum* [in press.]

SMITH, S.G. 1995. *Schoenoplectus*. In: Flora of North America, convening ed. N.T. Morin & Editorial Committee, Vol. 11. Oxford University Press, Oxford, England [in press.]

SOJÁK, J. 1972. Doplnky k nomenklature nekterych rodo (Phanerogamae). *Cas. Nar. Muz.* (Prague) 141: 62.

SYME, J.T.I.B. 1870. In: Sowerby, English Botany, 3rd edn. 10: 63.

VAHL, M. 1805. Cyperaceae. *Enum. plantarum* 2: 207–392. Hauniae & Lipsiae, København.

WILSON, K.L. 1981. A synopsis of the genus *Scirpus sens. lat.* (Cyperaceae) in Australia. *Telopea* 2: 153–172.